

# **VEHICULAR MONITORING SYSTEM WITH A MULTI-WINDOW DISPLAY**

## **BACKGROUND OF THE INVENTION**

### **1. Field of the Invention**

The present invention is related to a vehicular monitoring system with a multi-window display, and more particularly to a multi-window monitoring system that can help vehicle drivers monitor changing conditions in usual blind spots around the vehicle using multiple video cameras and ultrasonic signal transceivers.

### **2. Description of Related Art**

Currently back-up detectors are becoming standard equipment in most passenger vehicles. The back-up detector is used to check the distance between the vehicle and any object behind the vehicle when the vehicle is in the reverse gear. The electronic detector has an array of ultrasonic sensors on the bumper which is connected to the gear box control circuitry and an alarm. When the vehicle is in the reverse gear and an object appears in the preset warning range, the electronic detector will initiate the alarm to warn the vehicle driver.

Therefore, this is an effective safety feature for passenger vehicles.

However, nothing is more realistic than seeing video images that actually present the road conditions. Modern drivers have become satisfied with only electronic detectors. They need an all-purpose monitoring device that allows them to see images taken from different angles simultaneously, especially in usual blind spots where the driver's view is blocked by the vehicle body. With such a monitoring device, the driver's visibility is greatly enhanced because the

1 driver is more aware of the changing conditions around the vehicle.

2 Also, conventional back-up detectors mounted on a vehicle with elevated  
3 bumpers cannot detect objects lying below the detection zone, but these objects  
4 do pose a real threat. If the vehicle runs over them unwarily, they can cause  
5 damage to the bottom of the vehicle.

6 To correct the foregoing problem, some manufacturers have incorporated a  
7 video camera and a display monitor in the detection systems. The monitor is  
8 either installed in the rearview mirror or as a stand-alone display on the  
9 dashboard in the driver compartment, such that images from the video cameras  
10 at the rear of the vehicle are simultaneously presented at the rearview mirror or  
11 stand-alone monitor during normal driving and parking. However, the present  
12 design of these detection systems with video display are only suitable for  
13 passenger vehicles, and the detection systems have only one video camera.

14 Large vehicles, The shape and size of vehicle bodies of large vehicles cause  
15 large vehicles to have more blind spots than a passenger car. Consequently,  
16 using one video camera to cover all possible angles is almost impossible.  
17 Furthermore, simultaneously displaying the video from several video cameras  
18 presents a significant technical problem. Some of the common problems for  
19 different types of detector systems are described below.

20 1. Hard-wired detector systems: Using several hard-wired detectors and  
21 video cameras creates complicated wiring configurations and raises the question  
22 of how to control multiple images from several video cameras on a common  
23 screen simultaneously.

24 2. Wireless detector systems: these detectors do away with much of the

1 electrical wiring, but in the case where several video cameras use the same  
2 frequency band or nearby vehicles have wireless detectors with similar  
3 frequency bands, video degradation will occur due to mutual interference.

4 The foregoing problems associated with the use of multiple video cameras  
5 need to be solved if simultaneous operation is to be achieved.

#### 6 SUMMARY OF THE INVENTION

7 The main objective of the present invention is to provide a vehicular  
8 monitoring system with a multi-window display that uses a window overlay  
9 technique so one monitor can simultaneously display multiple video images. The  
10 multiple video images are taken by several video cameras mounted at different  
11 positions on a vehicle. Therefore, the vehicle driver is more aware of the  
12 conditions around the vehicle and is not subject to blind spots.

13 To this end, the present invention provides a vehicular monitoring system  
14 that is formed by a data collection assembly, a console unit, multiple video  
15 cameras and a monitor. The video cameras are installed around the vehicle at  
16 locations to cover blind spots.

17 The data collection assembly essentially comprises an assembly controller,  
18 a wireless signal transmitter and multiple ultrasonic signal transceivers. The  
19 assembly controller receives signals from the ultrasonic signal transceivers,  
20 processes the signals and sends the processed signals to the console unit.

21 The console unit is connected to the multiple video cameras to receive  
22 video images from different angles around the vehicle. The signals from the  
23 ultrasonic signal transceivers and the video cameras are digitized, compressed  
24 and output as either single-channel or multiple-channel video signals to the

1 monitor for simultaneous display by using a window display technique.

2 By using this synchronous control of the multiple video cameras and the  
3 ultrasonic signal transceivers, the present invention increases the driver's  
4 visibility, obviating usual blind spots around the vehicle and enhances driving  
5 and parking safety with accurate measurement of distances to objects.

6 Other objectives, advantages and novel features of the invention will  
7 become more apparent from the following detailed description when taken in  
8 conjunction with the accompanying drawings.

#### 9 BRIEF DESCRIPTION OF THE DRAWINGS

10 Fig. 1 is a functional block diagram of a vehicular monitoring system with a  
11 multi-window display in accordance with the present invention;

12 Fig. 2 is a circuit diagram of part of a data collection assembly in Fig. 1;

13 Fig. 3 is a circuit diagram of a signal processing circuit in the data collection  
14 assembly in Fig. 1;

15 Fig. 4 is a circuit diagram of part of a console unit in Fig. 1;

16 Fig. 5 is a circuit diagram of an image overlay controller in Fig. 1;

17 Fig. 6 is a standard display format on a multi-window display; and

18 Fig. 7 is a diagram of the suitable positions around a large vehicle for  
19 installation of ultrasonic signal transceivers and video cameras.

#### 20 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

21 With reference to Fig. 1, the present invention provides a multi-window  
22 monitoring system installable on large vehicles. The system has more than one  
23 video camera (50) and multiple ultrasonic signal transceivers (20) installed at  
24 different locations on the large vehicle. The video cameras (50) can be installed

1 at locations to cover usual blind spots when the vehicle makes a turn or is in  
2 reverse gear. The ultrasonic signal transceivers (20) can be installed on sides of  
3 the vehicle and on the vehicle bumpers to determine the distance to any object  
4 that the vehicle is approaching. An alarm (33) is initiated to warn the vehicle  
5 driver when the vehicle approaches an object within a preset threshold range.

6 The multi-window monitoring system comprises a data collection assembly  
7 (10), a console unit (30), multiple video cameras (50) and a monitor (60).

8 With further reference to Figs. 2 and 3, the data collection assembly (10)  
9 comprises an assembly controller (11), a memory device (111), multiple signal  
10 processing circuits (21), multiple ultrasonic signal transceivers (20), a wireless  
11 signal transmitter (12) and a power supply unit (not numbered).

12 The assembly controller (11) has multiple inputs and outputs and receives,  
13 converts and formats data for further transmission.

14 The memory device is connected to (111) and stores all ultrasonic signal  
15 transceiver identification codes.

16 The multiple signal processing circuits (21) are connected to inputs of the  
17 assembly controller (11) and respectively comprise a microprocessor (211), an  
18 ultrasonic signal transceiving circuit (212), a signal amplifier (213) and a signal  
19 converter (214).

20 The microprocessor (211) is connected to the assembly controller (11) to  
21 feed digitized signals to the assembly controller (11)

22 The multiple ultrasonic signal transceivers (20) are connected respectively  
23 to the signal processing circuits (21), transmit ultrasonic signals, receive  
24 ultrasonic echoes and send the ultrasonic echoes to the assembly controller (11).

1       The wireless signal transmitter (12) is an RF signal transmission module, is  
2       connected to the output of the assembly controller (11), receives data processed  
3       by the assembly controller (11) and transmits the processed data as an RF signal.

4       The wireless signal transmitter (12) uses an antijamming technique to avoid  
5       mutual interference. The antijamming technique may be frequency hopping,  
6       spread spectrum technique or the like.

7       With reference to Fig. 1 and 4, the console unit (30) comprises a unit  
8       controller (31), a signal receiver (32), an alarm (33), an image overlay controller  
9       (40) and a power supply unit (not numbered), has multiple inputs (not numbered)  
10      and outputs (not numbered), receives and processes data from the assembly  
11      controller (11) to determine when distance thresholds have been exceeded,  
12      formats video data from multiple sources for simultaneous presentation and  
13      initiates and presents warnings when distance thresholds have been exceeded.

14      The signal receiver (32) is an RF signal transmission module, is connected  
15      to an input of the unit controller (31) and receives RF signals from the wireless  
16      signal transmitter (12).

17      The alarm (33) is connected to an output of the unit controller (31) and  
18      sounds an audible warning, a visual warning or both when initiated by the unit  
19      controller.

20      The unit controller (31) receives signals from the data collection assembly  
21      (10), verifies the signal sources, analyzes the data to determine whether to enable  
22      the console operations when a preset condition is fulfilled, activates presentation  
23      of video data and initiates warnings.

24      The memory device (311) stores identification codes of all ultrasonic signal

1 transceivers (20) and preset conditions and thresholds.

2 With further reference to Fig. 5, the image overlay controller (40) has  
3 multiple video input terminals (not numbered), a data input terminal (not  
4 numbered) and a video output terminal (not numbered) and comprises a  
5 programmable video controller (41), a multiplexer (42), an A/D signal converter  
6 (421), a horizontal-sync signal separation circuit (422) a buffer (43) and a D/A  
7 converter (44). The data input is connected to an output of the unit controller  
8 (31).

9  
10 The programmable video controller (41) includes a temporary memory  
11 (411) and has multiple inputs (not numbered) and multiple outputs (not  
12 numbered).

13 The multiplexer (42) has multiple video inputs (not numbered) and multiple  
14 outputs (not numbered).

15 The A/D signal converter (421) is connected to an output of the multiplexer  
16 (42) and inputs of the programmable video controller (41) that sends video data  
17 to the temporary memory (411).

18 The horizontal-sync signal separation circuit (422) is connected to an  
19 output of the multiplexer (42) and inputs to the programmable video controller  
20 (41).

21 The buffer (43) is connected to an input of the programmable video  
22 controller (41) and to an output of the unit controller (31) that sends a copy of the  
23 distance data from the data collection assembly (10).

24 The D/A converter (44) is connected to an output of the programmable

1 video controller (41), which converts the superimposed images to produce  
2 single-channel or multiple-channel video signals.

3 The programmable video controller (41) through the multiplexer (42)  
4 controls the switching of the display window either sequentially or randomly.

5 The programmable video controller (41) works in conjunction with the  
6 horizontal-sync signal separation circuit (422) to separate out the horizontal-  
7 sync signals and the A/D signal converter (421) to convert video signals to  
8 digitized images, and then the converted data are written into the temporary  
9 memory (411) using a predetermined clock.

10 Another function of the programmable video controller (41) is to correlate  
11 the distance data and the video images, such that the distance data can be  
12 superimposed over corresponding images. Then, the superimposed images are  
13 compressed and converted to produce one-channel or multiple-channel video  
14 signals through the signal converter (44). Thereafter, the converted

15 With further reference to Fig. 6, the monitor (60) has a video and control  
16 input (not numbered), a control output (not numbered), a touch-screen with  
17 multiple function keys. Video signals from the signal converter (44) are  
18 presented on the monitor (60) as images in several windows simultaneously, and  
19 the distance data are superimposed over video images.

20 With reference to Fig. 7, tractor trailers (70) usually have a long and bulky  
21 trailer. When the tractor trailer makes a turn, , the trailer (71) causes many blind  
22 spots. However, multiple video cameras (50) and ultrasonic signal transceivers  
23 (20) installed on the edges of the trailer (71) make the vehicle driver more aware  
24 of the conditions around the vehicle by displaying video images and distance



1 data continuously on the monitor.

2 A preferred embodiment of the vehicular monitoring system with a multi-  
3 window display uses three video cameras (50) and three ultrasonic signal  
4 transceivers (20) corresponding respectively to the video cameras (50). These  
5 video cameras (50) and ultrasonic signal transceivers (20) are installed at  
6 different locations around the sides and back of the trailer (71), and the monitor  
7 (60) is set up with multiple windows to simultaneous display of images from the  
8 video cameras (20) shooting at different angles. The distance data are obtained  
9 from the ultrasonic signal transceivers (20) and superimposed on the video  
10 images. The distance data are continuously updated as the vehicle gets closer to  
11 an object.

12 The monitor (60) has a touch screen with built-in function keys, and the  
13 monitoring system provides several display modes for displaying images and  
14 distance data. The vehicle driver can choose to present the images from a  
15 particular video camera using full screen display, or simultaneous display of all  
16 windows. Since the monitor (60) is connected to the unit controller (60), the unit  
17 controller (31) notifies the programmable video controller (41) and orders the  
18 multiplexer (42) to switch to the chosen display mode as soon as the vehicle  
19 driver makes a selection on the touch screen.

20 When the vehicle body gets within a preset threshold range of an object, the  
21 unit controller (31) will cause the alarm (33) to emit a beeping sound that  
22 increases in frequency as the vehicle approaches the object. As long as the object  
23 detected by the ultrasonic signal transceivers (20), the unit controller (31)  
24 continuously feeds the distance data through the image overlay controller (40) to

1 the monitor screen to keep the vehicle driver informed of the current distance  
2 between the vehicle body and the object.

3 The multi-window monitoring system is able to cover all blind spots around  
4 the vehicle. Therefore, the system is suitable for large vehicles and keeps the  
5 vehicle driver more aware of the changing road conditions. Therefore, the  
6 driver's visibility and driving safety can be considerably enhanced.

7 Another advantage of the present invention is that the multi-window  
8 monitoring system is operated by wireless signal transmission. Therefore the  
9 system installation can be easily accomplished without a large amount of wiring  
10 and connections.

11 It is to be understood, however, that even though numerous  
12 characteristics and advantages of the present invention have been set forth in the  
13 foregoing description, together with details of the structure and function of the  
14 invention, the disclosure is illustrative only, and changes may be made in detail,  
15 especially in matters of shape, size, and arrangement of parts within the  
16 principles of the invention to the full extent indicated by the broad general  
17 meaning of the terms in which the appended claims are expressed.